

T01D04 – SL/HL Chem 1

% Composition and Empirical Formula

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" Kiss me and I'll let you have my formula !"



PERIODS -

**SIMILARITIES: THE NUMBER OF
OUTER ELECTRON SHELLS.**

H	
Li	Be
Na	Mg
K	Ca
Rb	Sr
Cs	Ba
Fr	Ra

					He
B	C	N	O	F	Ne
Al	Si	P	S	Cl	Ar
Ga	Ge	As	Se	Br	Kr
In	Sn	Sb	Te	I	Xe
Tl	Pb	Bi	Po	At	Rn

Se	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn						
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd						
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg						
Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds								

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

GROUPS –

SIMILARITIES: THE NUMBER OF ELECTRONS IN THE OUTER SHELL. COMMON REACTIVITY, BONDING, CHEMICAL AND PHYSICAL PROPERTIES.

H	<div>ELECTRONS IN THE OUTER SHELL. COMMON REACTIVITY, BONDING, CHEMICAL AND PHYSICAL PROPERTIES.</div>																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Se	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds								

METALIC PROPERTIES

NON METALS

**SIMILARITIES: AN ELEMENTS
RELATIVE ABILITY TO CONDUCT
ENERGY IN THE FORM OF HEAT
OR ELECTRICITY.**

THE "STAIR"

SIMILARITIES: AN ELEMENTS RELATIVE ABILITY TO CONDUCT ENERGY IN THE FORM OF HEAT OR ELECTRICITY.										THE “STAIR”					He		
H																He	
Li	Be									B	C	N	O	F	Ne		
Na	Mg									Al	Si	P	S	Cl	Ar		
K	Ca	Se	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds								

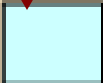


METALS

METALLOIDS

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

		Alkali Metals										Metalloids					Non-metals					Halogens					
H																								He			
Li	Be	Alkaline Earths										Weak/Poor Metals					B	C	N	O	F			Ne			
Na	Mg	Transition Metals															Al	Si	P	S	Cl			Ar			
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr										
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe										
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn										
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds																		
		Lanthanides										Noble Gases															
		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu												
		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr												
		Actinides																									

What charge ions do atoms want to form?

1+	2+			3+	4	3-	2-	1-	0
I	II			III	IV	V	VI	VII	0
H •									He ••
Li •	Be ••			B ••	C ••	N ••	O ••	F ••	Ne ••
Na •	Mg ••			Al •	Si ••	P ••	S ••	Cl ••	Ar ••
K •	Ca ••			Ga •	Ge ••	As ••	Se ••	Br ••	Kr ••
Rb •	Sr ••			In •	Sn ••	Sb ••	Te ••	I ••	Xe ••
Cs •	Ba ••			Tl •	Pb ••	Bi ••	Po ••	At ••	Rn ••
↓	↓			↓	↓	↓	↓	↓	↓
 Metal	 Metalloid			 Nonmetal					



What elements form what compounds?

- M/NM = Ionic
 - Because they have ions
 - Metal (cation +) and Non-metal (anion -)
 - Have a set ratio of elements
- NM/NM = Covalent/Molecular
 - Because they must share electrons
 - Various compounds (CO , CO₂ , CO₃)



Empirical vs. Molecular

- What ionic compound forms between Mg^{2+} and O^{2-} ?
- What ionic compound forms between Pb^{4+} and O^{2-} ?
- Ionic compounds are always in the simplest whole number ratio, known as the empirical formula!



Covalent Compounds

- Is carbon dioxide an empirical formula?
 - Simplest ratio = CO_2
- Is methanol (CH_3OH) an empirical formula?
 - Simplest ratio = CH_3OH
- Is tetraphosphorous decoxide (P_4O_{10}) an empirical formula?
 - Simplest ratio = P_2O_5 (empirical formula)
 - Actual ratio = P_4O_{10} (**molecular formula**)



Def: Types of Formulas

Empirical formula: the lowest whole number ratio of atoms in a compound.

Molecular formula: the true number of atoms of each element in the formula of a compound.



Formulas (continued)

Formulas for ionic compounds are ALWAYS empirical (lowest whole number ratio).

Examples:



Formulas (continued)

Formulas for molecular compounds MIGHT be empirical (lowest whole number ratio).

Molecular:



Empirical:

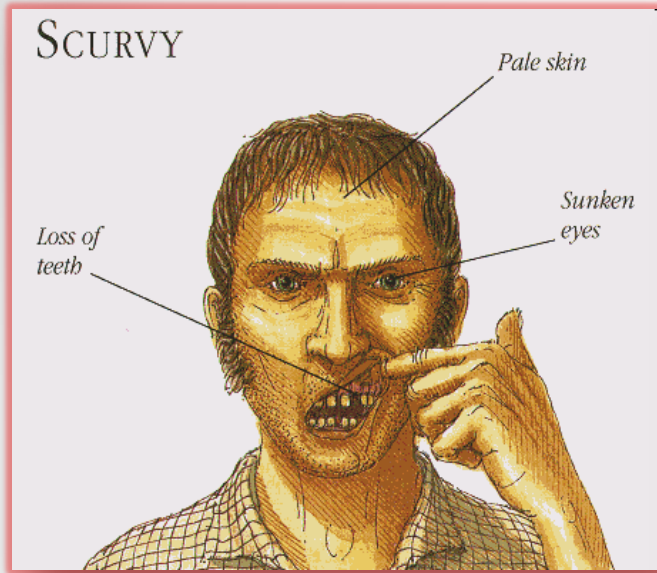


Finding the Empirical Formula

- Do all elements have the same mass?
 - H – 1.01 g/mol
 - O – 16.00 g/mol
 - Fe – 55.85 g/mol
- Therefore if we have a compound with 50% H and 50% O by mass it will NOT have a formula of HO, will it?



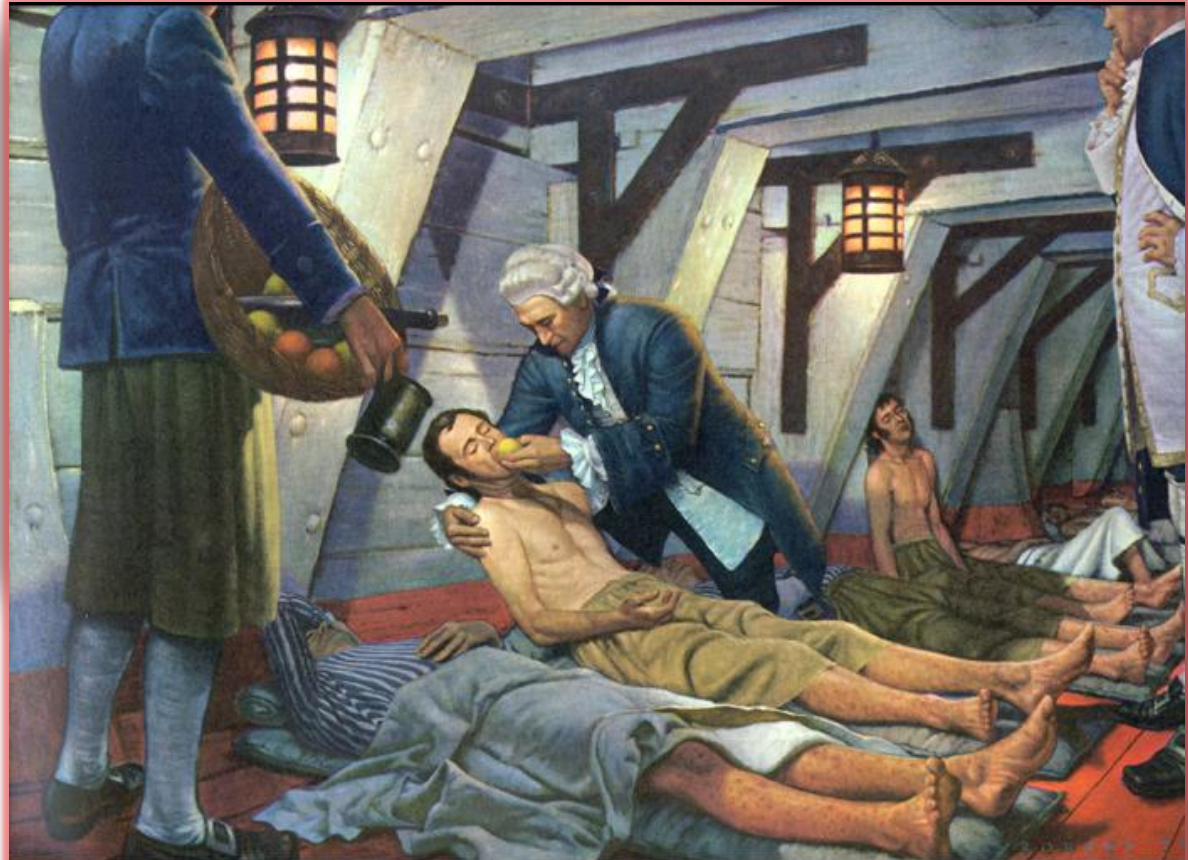
What is Scurvy?



A vitamin
deficiency!

How is it
cured?

CHEMISTRY



James Lind, a surgeon in the Royal Navy, conducted clinical tests that proved that citrus fruits and their juices would cure and prevent scurvy, the disease which killed a million seamen between 1600 and 1800. In this painting he is shown aboard HMS *Salisbury* in 1747. Lind published his paper, *A Treatise on the Scurvy* was published in 1751. He later became Chief Surgeon of the Royal Naval Hospital and published many more papers on how to safeguard the health of sailors.

Image from *A History of Medicine in Pictures*, published by Parke, Davis & Co. in 1960; Artist: Robert A.Thom

Vitamin C!

- So, lets use vitamin C as our example, follow along on your notesheet.

